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Building for Bandwidth

Choosing the Proper Cabling Infrastructure

ADC®

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Introduction

Over the past thirty-plus years there has been an unprecedented progression of networking technology. Since the early 1970's with the invention of Ethernet, rates for point-to-point data transfer have increased by a factor of ten thousand. From one Mb/s StarLan to 10 Gb/s Ethernet, the steady increase in bandwidth has been fueled by an ever increasing demand for more—more speed, more applications, more memory and more devices.

This demand for more emanates from continual increases in processor capability and advanced operating systems that enable development of new applications. These applications and their associated devices create more network usage and congestion, driving need for more bandwidth. The need for this additional bandwidth is seen first at network bottlenecks. When a section of the network becomes a bottleneck, network equipment, such as Ethernet switches and servers, are replaced with the next generation of equipment with faster processors, more memory, improved operating systems and the inherent ability to run more complex applications.

Over time, network equipment speeds outpace the infrastructure that connects the devices. A good example of this is seen with the transition of 10Base-T to 100Base-TX. Networks with category 3 cabling systems could support the first few generations of switches and computers that supported 10 Mb/s Ethernet over 100 meters. With the introduction of the 100Base-TX protocol, bandwidth limitations between devices were apparently removed. However, category 3 cabling was insufficient to support this 10x increase in bandwidth—which led to development of category 5 cabling to support 100 Mb/s over 100 meters.

Ignoring category 4, which came and went rather quickly, network planners faced a decision on which cabling system to install. At that time, the majority of networks operated with 10Base-T network devices. Yet category 3 cabling would not support the emerging 100Base-TX protocol. The good news was that category 5 would run 100Base-TX and was backward compatible with category 3 so that any application designed for category 3 (10Base-T) would run just as well, if not better, on category 5 cabling systems. At this point in time, the logical choice was to install category 5 in anticipation of applications requiring 100Base-TX.

Selecting the Infrastructure—Follow the Lead of IEEE

The same scenario faces network planners today as cabling systems are designed to withstand multiple replacements of active equipment. Most active network equipment, including computers, servers, Ethernet switches, routers and hubs, have a maximum useful life of three to five years before they are obsolete and need to be replaced by their next generation of equipment. By contrast, structured cabling historically has seen a useful life of 10 to 15 years. History says that the structured cabling that you install today must sustain at least three generations of networking equipment upgrades.

The challenge is how to determine what types of active equipment will exist in three product generations. The answer can be found with IEEE. This organization consists of networking equipment manufacturers such as Cisco, Nortel, Juniper and others that look at the future of networking and develop solutions for future product generations. Using the IEEE as a guide, it is possible to see the direction for both active equipment and cabling requirements for the next few generations.

The IEEE has already released standards for 10GbE over fiber and over short range copper (CX4), and is rapidly progressing with IEEE 802.3an, 10GbE over un-shielded twist pair copper (UTP), with ratification expected in July 2006. Other standards bodies are active, too, especially TIA and ISO committees with their work on Augmented category 6, also known as category 6a. With the advent of these new standards it is clear that the IEEE has set a direction that 10GbE over UTP is going to be a reality in upcoming generations of network equipment and this is fully supported by the standards making bodies, TIA and ISO.

IEEE Standards Activity

IEEE 802.3z	Gigabit Ethernet over Fiber	Released 1998
IEEE 802.3ab	1000Base-T (Gigabit Ethernet over UTP)	Released 1999
IEEE 802.3ae	10GbE over Fiber	Released 2002
IEEE 802.3ak	10GbE over short range Copper (CX4)	Released 2003
IEEE 802.3an	10Gbase-T (10GbE over Copper)	July 2006 (Estimate)

Focus on the Critical Decision Criteria

The questions remains—with all the fiber and copper cabling choices at your disposal, which do you install today? The simple answer is—it depends, because each network is unique. In fact, any vendor that offers a one-size-fits-all solution or just narrow choices cannot consider the unique circumstances of your network. For example, some companies will insist that an Augmented category 6 solution is your only solution, often before asking a few questions.

Instead, as you make your cabling infrastructure decision, regard the following two criteria: bandwidth requirements and time. For illustration, here are just three possible scenarios based upon very different network requirements.

- *You need 10 GbE right now.* If this is the case, choose 10GbE over fiber. It is going to be more expensive than copper, due to media conversion and more expensive ports on equipment. Yet remember the IEEE 802.3an standard will not be released until July 2006, and it will be a period of time before the first solutions hit the market following the release of this standard.

- *You are not sure what to do, you occupy space on a short-term lease, or you are concerned about the current state of the standards.* In this case, the logical choice is a category 6 cabling solution. After all, you may not be in the building very long and standards for Augmented category 6 are not final. Once the standard is released, it appears as though category 6 will support 10GbE at the shorter distance of 55 meters, just in case you do require 10GbE in the near term.

In this scenario, why is category 5 not a good choice? In 2005, the dominant UTP cabling standard for new installations shifted from category 5e to category 6. In addition, category 5e is not recognized by IEEE or TIA to support 10Gbase-T because category 5e cannot support 10GbE for any practical distance. There were some early announcements on 10GbE running on category 5e. Yet these tests were only done on single runs of cable in a laboratory environment, not on actual installations. In actual installations the noise generated by adjacent cables (alien crosstalk) is too great to allow 10GbE transmission for any reasonable distances over category 5e cabling.

- *Building space is on a long term lease or the building is owned. Bandwidth requirements are substantial.* Choose Augmented category 6. History says your investment upfront will pay off in the long term. Augmented category 6 will be more expensive than category 6. However, the installation time and cost will be virtually the same. For this scenario, Augmented category 6 offers a cabling system that will be operable for at least three generations of active network gear. In the scope of any networking project, the infrastructure is a relatively small expense. Adding the small capital expense for Augmented category 6 cabling will defer or eliminate future costs of cabling system upgrades as new applications require replacement of active networking gear.

Summary

Technology advancements in networking will continue. New processor technology, coupled with new operating systems, will allow the creation of advanced applications and services. These new applications will demand more and more bandwidth, driving the need for higher speed protocols and cabling to support these protocols. Your situation may dictate a fiber or a category 6 solution. Yet if you own your space or have a long term lease, a good rule of thumb is to design your passive cabling infrastructure to endure at least three generations of active networking gear with an Augmented category 6 solution. To design for three generations, look to the IEEE and educate yourself on the protocols being developed for the future. This offers an invaluable guide toward building for bandwidth in the future.

Conclusion

ADC manufactures and distributes a complete portfolio of standards-based, technologically superior solutions that support voice, data, security, audio, video, controls and other building and campus systems. The TrueNet® Structured Cabling Solution provides a complete copper and fiber cable, connectivity and cable management solution from the entrance facility to the desk top and across the campus. Supported by an exceptional warranty, TrueNet is the choice of network manager worldwide who operate high-value networks.

The chart below shows just a few of the ADC cable solutions used to support common enterprise applications. Integral to each solution are the TrueNet patch panels, fiber frames, connectors, cable management, termination/splice/storage panels and other products for every unique requirement in the passive portion of your network.

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IEEE Standard	Designation	Bandwidth	Distance Limitation	Common Applications	ADC TrueNet® Solutions
802.3ab	1000Base-T	1000 Mb/s	100 meters	Desktop Computing	• Category 5e and 6 • CopperTen Augmented Category 6
802.3z	1000Base-SX	1000 Mb/s	220 to 550 meters	Enterprise backbone	• Laser Optimized Multimode Fiber
	1000Base-LX	1000 Mb/s	5 Kilometers	WAN, MAN	• Singlemode Fiber
802.3an	10GBase-T	10 Gb/s	100 meters (Cat 6a), 55 meters (Cat 6)	Data Center, R&D Computing, High Resolution Video, Advanced Desktop Computing	• CopperTen Augmented Category 6 • Category 6
802.3ae	10GBase-SR/SW	10 Gb/s	300 meters	Data Center and Enterprise Backbone Cabling	• Laser Optimized Multimode Fiber
	10GBase-LR/LW	10 Gb/s	10 Kilometers	WAN, MAN	• Singlemode Fiber
	10GBase-ER/EW	10 Gb/s	40 Kilometers	WAN	• Singlemode Fiber
	10GBase-LX-4	10 Gb/s	300 meters	Data Center and Enterprise Backbone Cabling	• Standard Grade Multimode Fiber
	10GBase-LX-4	10 Gb/s	10 Kilometers	WAN, MAN	• Singlemode Fiber
802.3af	Power over Ethernet	10/100/ 1000 Mb/s	100 meters	VoIP, WiFi, RFID, IP Security	• Midspan PoE

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